

**Deepwater Program: Exploration and Research of Northern Gulf of Mexico
Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral
Communities: Reefs, Rigs and Wrecks**

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LONG-TERM GOALS

A primary goal of this study is to obtain a robust predictive capability for the occurrence of rich cnidarian (primarily scleractinian coral) hard ground communities in the deep Gulf of Mexico. To achieve this long-term goal, this study will accomplish three interrelated and interdependent objectives

OBJECTIVES

The objectives of this study are:

- 1) Discover and describe new locations at greater than 300m depth in the GoM with extensive coral community development, particularly including *Lophelia pertusa*.
- 2) Gain a more comprehensive understanding of the fundamental processes that control the occurrence and distribution of *Lophelia* and other extensive coral communities at depths greater than 300 m in the GoM through both laboratory experiments and field data collection.
- 3) Document and understand the relations between coral communities on artificial and natural substrates with respect to community composition and function, phylogeographic and population genetics, and growth rates of the key cnidarian foundation fauna.

Our specific biological objectives:

- 1) To discover and characterize new sites:
 - a. Characterize key sites at the largest scale with high resolution bathymetry, side scan sonar imaging, 3D seismic data, and current models
 - b. Characterize the coral density at all study sites at the 10 to 100 m scale with randomized photo transects and general site descriptions.
 - c. Characterize the community composition at the 1 to 10 m scale at significant coral sites (man-made and natural) with analysis of close up imagery, replicate 5x5m photomosaics, and quantitative community collections.
- 2) Analyze connectivity among all sites in the GoM (man-made and natural), and to other sampled populations, with comparative community, phylogeographic and population genetic analyses.
- 3) Compare the structure, species richness and diversity of communities tightly associated with *Lophelia* on man-made structures and from natural sites in the GoM
- 4) Experimentally determine the tolerance and growth response of *Lophelia* to temperature, pH/alkalinity, dissolved oxygen and electrical current.
- 5) Characterize and constrain growth rates of key species of colonial cnidarians (pioneer colonies) using analyses of images of the largest colonies on man-made structures of known age.
- 6) Characterize key variables at sites with the most significant communities of coral colony development over one year by monitoring temperature, currents, larval seasonal distribution and sediment quality and quantity at 2-4 sites between 2009 and 2010.

By integrating this information, we will develop a predictive model to examine the potential occurrence of significant assemblages of *L. pertusa* or other cnidarians at unexplored sites and artificial reefs in the deep GoM.

OTHER OBJECTIVES

1. Historical shipwreck component. Study of up to six (6) shipwrecks to determine identity, site boundaries, National Register eligibility, preservation state and stability, associated biological communities and artificial reef effects.

- a. Determine rate of deterioration of test coupons at platforms or shipwrecks
2. Coordination with USCG
3. Deepwater commercial fisheries review that impact hard bottom communities

APPROACH AND WORK PLAN

Key individuals participating in this work and their roles are:

- Dr. James Brooks is the Project Manager and takes the lead in administration of this project,
- Dr. Charles Fisher (Pennsylvania State University) coordinates the biological studies,
- Dr. Erik Cordes (Temple University) takes responsibility for the live *Lophelia pertusa* experiments, gorgonian genetics, and coordinate the phylogeography and taxonomy team,
- Dr. Harry Roberts (Louisiana State University) coordinates the geological/geophysical and oceanographic studies,
- Mr. Dan Warren and Mr. Rob Church from C&C Technology coordinate the wrecks studies along with,
- Dr. Chris German (WHOI) who coordinates the time series sediment trap studies,
- Dr. Ian MacDonald (Florida State University) directs the deployment and analyses of the time lapse cameras and imagery
- Ms. Liz Goehring (Penn State and NSF Ridge 2000 office) coordinates the education and outreach activities.
- Dr. William Schroeder assists in the analysis of coral communities on rigs and wrecks and also participates in the over-all study synthesis phase.
- Dr. Tim Shank conducts studies on the population genetics of several coral associated taxa.
- Dr. Iliana Baums oversees development of molecular markers for studies of population connectivity in antipatharians and assists in the construction of *Lophelia* maintenance aquaria.
- Dr. Stephen Cairns is responsible for the identification of the hard coral samples collected.
- Peter Etnoyer oversees the classical taxonomy of octocorals
- Dr. Dennis Opresko the classical taxonomy and phylogeography of antipatharians.
- Dr. Bernie Bernard, TDI-Brooks Director and Chief Technology Officer, will coordinate the navigation and logistics portion of the project.
- Dr. Gary Wolff will act as the projects Data Manager as he has for other BOEM projects including the Chemo-series.

WORK COMPLETED

Four cruises have been completed since *Lophelia II* began. **Table 1** summarizes the dates, ships used and primary exploration equipment.

Cruise	Dates	Ship	Equipment
1	2 September - 2 October 2008	<i>Nancy Foster</i> - NOAA	ROV <i>SeaVision</i>
2	16 June - 1 July 2009	<i>RV Brooks McCall</i> – TDI-Brooks	AUV <i>Sentry</i>
3	19 August - 12 September 2009	<i>Ron Brown</i> - NOAA	ROV <i>JasonII</i>
4	13 October - 4 November, 2010	<i>Ron Brown</i> - NOAA	ROV <i>JasonII</i>

RESULTS

- increased accuracy of locating natural hard bottom areas associated with fluid-gas expulsion and deep-water coral communities to the deepest parts of the continental slope.
- deepest known occurrence of both *Leiopathes* and *Lophelia* in the Gulf of Mexico (GoM): 627m
- made the shallowest collection of a chemosynthetic tubeworm in the GoM - 320m
- collected information on 25 natural sites, six wrecks and four rigs
- of the 25 natural sites, 15 had never before been explored and 11 contained previously unknown coral communities
- extensive imaging including establishment of numerous long-term photographic monitoring stations
- discovered an area approximately 7 nm from MC252 that contained a small field of corals that were apparently impacted by the Deepwater Horizon Incident

IMPACT AND APPLICATIONS

National Security

This program will provide critical information on the exploration, characterization and function of hard-ground communities to BOEM. As manager of the nation's seafloor mineral resources, BOEM will use this information to aid in the development of critical energy resources, which may affect domestic energy production.

Economic Development

Increased energy and mineral production will have a positive economic impact at numerous levels in industry.

Quality of Life

Information on the location and functioning of hardground communities gathered by this program will have a positive impact on other ocean users, the natural environment, and the human environment. It will aid in minimizing the environmental impact on sensitive habitat and mitigate any potential damage to these communities.

Science Education and Communication

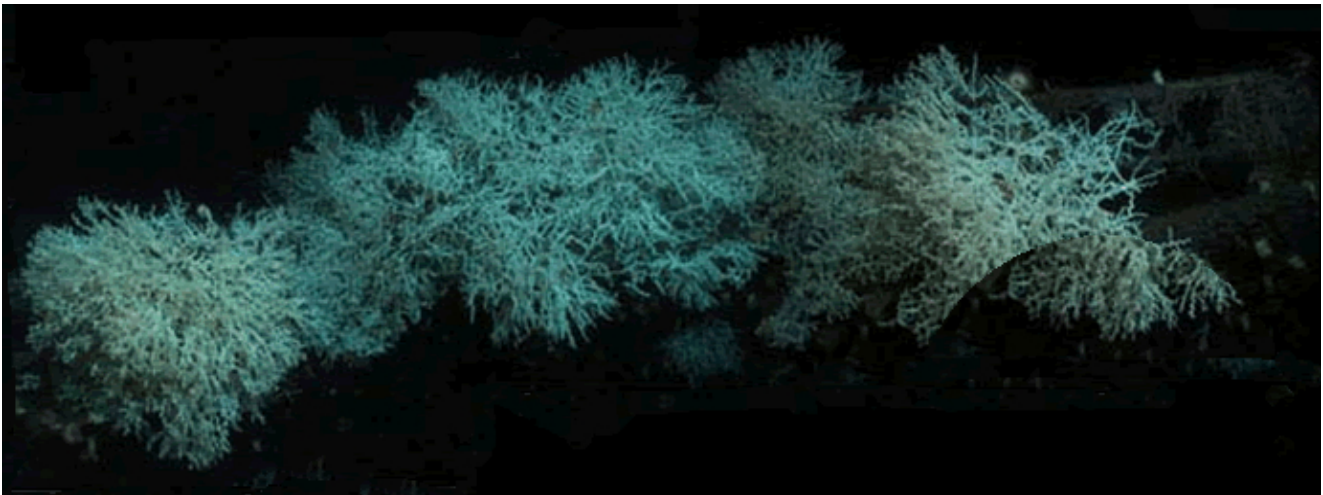
Education outreach efforts outside of the cruise website build on and leverage from the success of both the NOAA OE educational materials and the existing FLEXE (From Local to Extreme Environments) educational project. Our objective is to develop a full instructional unit on deep-sea coral ecology integrated with the NOAA/OE lessons, multimedia modules and Ocean Explorer website featured as the GLOBE FLEXE campaign for the 2010-2011 academic year.

TRANSITIONS

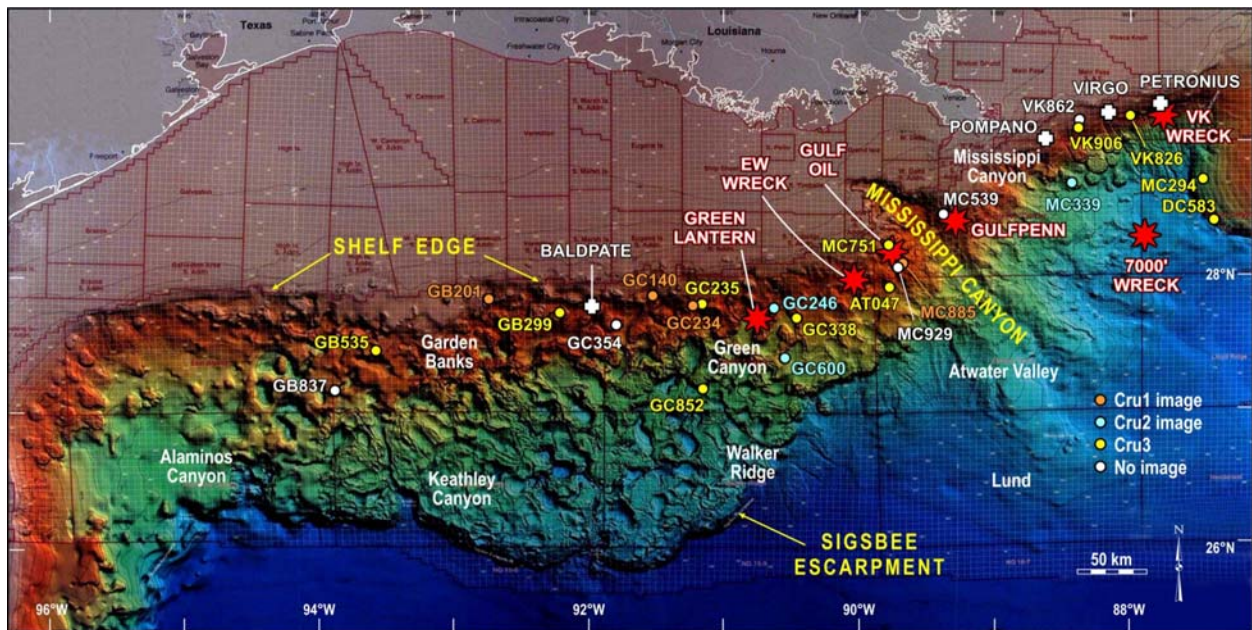
Data is provided to the ChEss database, which is a component of the Census of Marine Life (CoML) Ocean Biogeographic Information System (OBIS) data base. This work will contribute significantly to the goals of the Atlantic Equatorial Belt studies of the ChEss program, particularly the components that will allow interpretation of our findings in the context of hard-ground habitats around the world.

RELATED PROJECTS

- Chemosynthetic Ecosystems Study (MMS Report 95-0021)..
- Stability and Change in Gulf of Mexico Chemosynthetic Communities (MMS Report 2002-036).
- The Deepwater Program: Northern Gulf of Mexico Continental Slope Habitat and Benthic Ecology (MMS contract 1435-01-99-CT-30991).
- Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico. (Award Number: *1435-01-05-39187*) <http://tdi-bi.com/chemo3/chemo-main.htm>



Gulf Oil wreck - deepest site with abundant Lophelia currently known in the GoM



Sites and wrecks visited during the Lophelia II program in the Gulf of Mexico

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